



مستشفى الملك فيصل التخصصي ومركز الأبحاث
King Faisal Specialist Hospital & Research Centre
مؤسسة عامة Gen. Org.



الجمعية السعودية لطب الطوارئ
Saudi Society of Emergency Medicine

3RD INTERNATIONAL RED SEA EMERGENCY MEDICINE CONFERENCE



Hope.. Hold On Pandemic Ends

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BLAST

By
Dr. Khalid Al Johani

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What is explosion ?

- An explosion is an event that occurs when a substance rapidly releases energy and produces a large volume of gaseous products. High-explosive, thermobaric, and nuclear detonations all provide this change in potential energy to kinetic injury in a very short period of time.

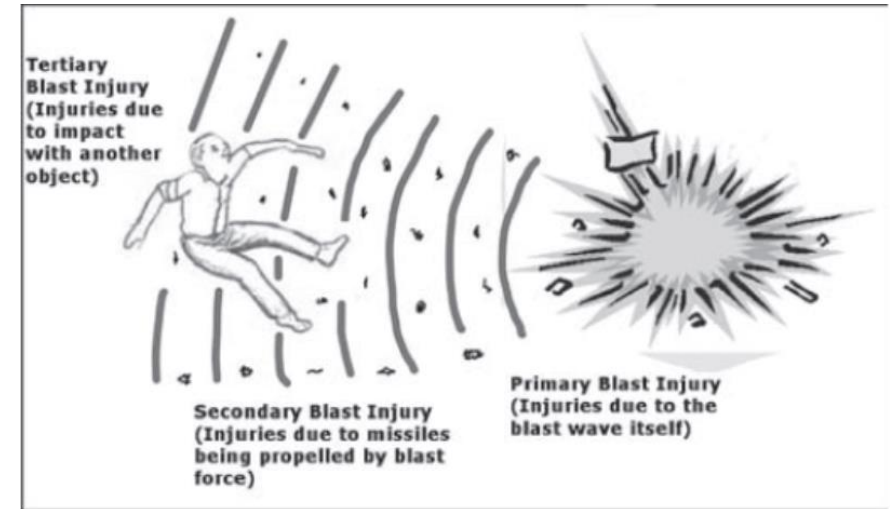


Illustration by Charles Stewart, MD. Used with permission of the author, © 2006, Charles Stewart. All rights reserved.



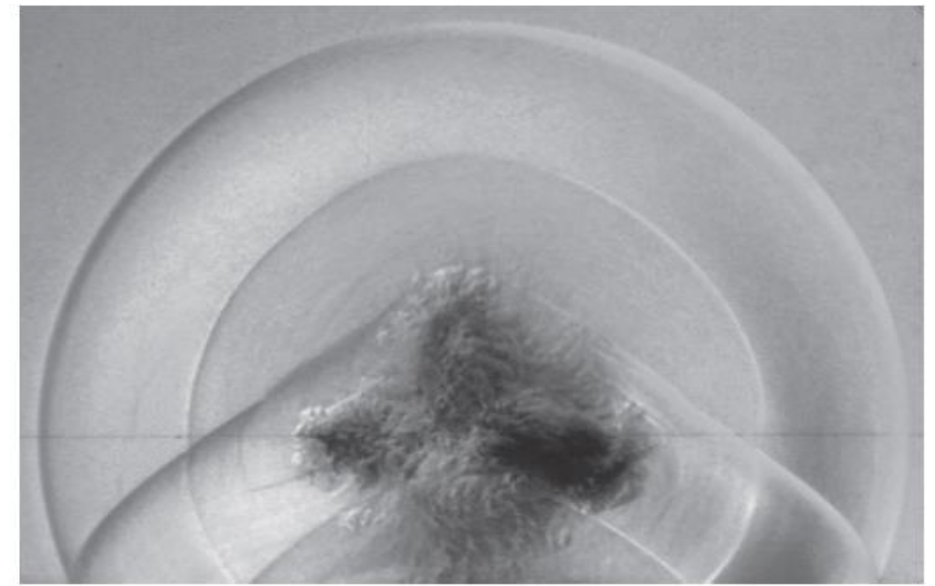


Nature of Explosives

- High-Order Explosives :A conventional explosion is the rapid chemical conversion of a solid or liquid into gas
 - Nitroglycerine
 - Dynamite
 - C-4 (Composition C-4 is a plastic explosive mixture of RDX explosive, plastic binders, and plasticizers)
 - Picric acid
 - Semtex is a general-purpose plastic explosive (first made by the Semtin Glassworks in the former Czechoslovakia, hence the name). It is similar to the US composition C-4 in characteristics and use.
 - Dynamite (A mixture of diatomaceous earth and nitroglycerin patented by Alfred Nobel in 1867)
 - Ammonium nitrate-fuel oil (ANFO) mixture
 - TNT (trinitrotoluene)
 - PETN
 - TATP (triacetone triperoxide, a nonnitrate high explosive)

The Damage:

- The extent of damage due to the pressure wave is dependent on:
 - The peak of the initial positive pressure wave (an
 - overpressure of 60-80 psi is considered potentially
 - lethal)
 - The duration of the overpressure
 - The medium in which it explodes
 - The distance from the incident blast wave
 - Focusing due to a confined area or walls

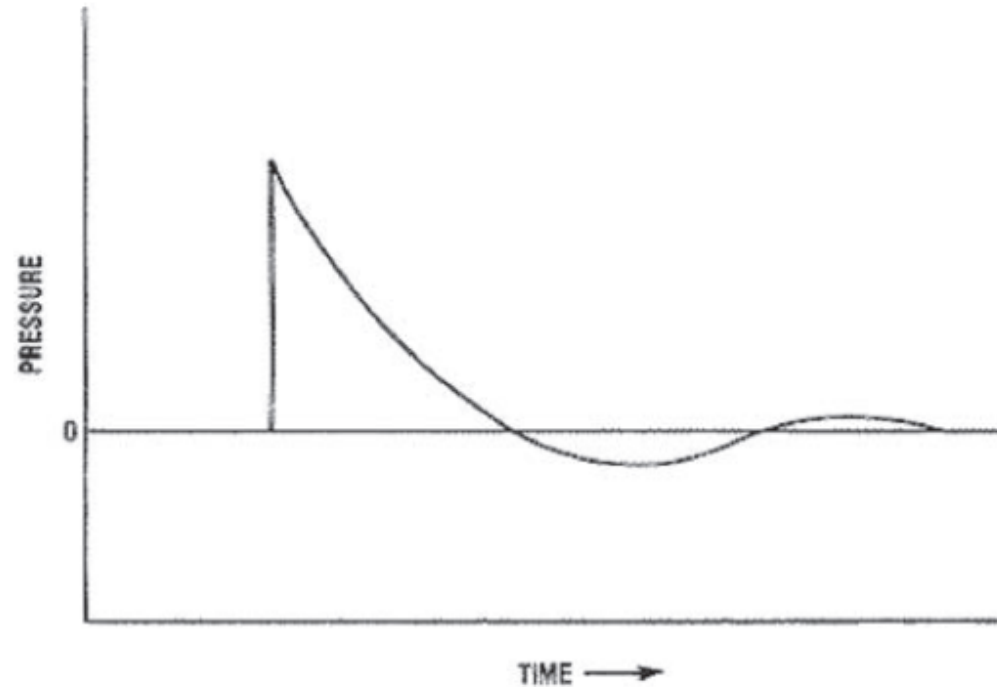


Courtesy Harald Kleine. Used with permission, © 2006, Harald Kleine. All rights reserved.



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1. single spike of increased pressure. The leading edge of the blast wave is called the blast front and is represented by this spike. The actual blast wave is only a few millimeters thick. This spike is also the most important factor in the pathology of primary blast injury.
 2. An exponential decay with time.
 3. A much longer duration negative pressure wave, with pressure below initial ambient pressure.

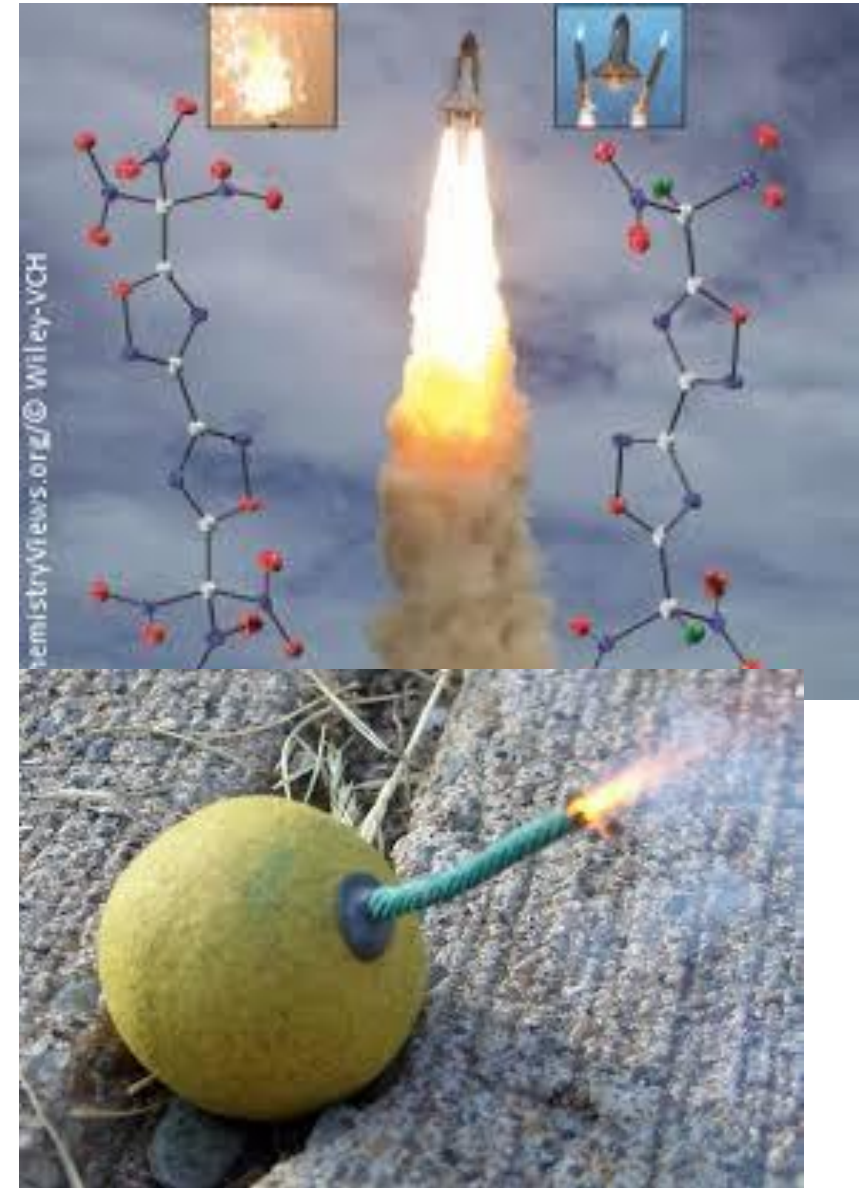
Idealized representation of pressure-time history of an explosion in air.



Courtesy Virtual Naval Hospital, Emergency War Surgery
NATO Handbook. Available at: <http://www.vnh.org>.

Low-order Explosives

- Low-order explosives are designed to burn and subsequently release energy relatively slowly. These explosives are often called propellants, because their most common use is to propel a projectile through the barrel of a weapon.
- The principle military uses for low-order explosives are as propellants and in fuses.



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- A large, black, cylindrical object, possibly a rocket or missile, is mounted on a red support structure. The object has a conical nose and is secured by several red straps. It is positioned vertically against a light-colored wall.



Medium in Which the Explosion Occurs

- Another important factor that defines blast injury patterns is the medium in which the blast occurs.
- An underwater blast wave causes far more damage, because water is essentially incompressible.^{2,16} A wave resulting from an underwater blast travels farther and moves faster than a wave from a similar explosion in the air. Blast injuries in water occur at greater distances and may be much more severe.



Blast Injury Pressure Versus Injury.

Overpressure (psi)	Effect
1-2	Frame house destroyed
3-5	Typical commercial construction destroyed
5	Tympanic membrane rupture (threshold)
15	Tympanic membrane rupture in 50% of patients
30-40	Possible lung injury (threshold)
40	Reinforced concrete construction destroyed
75	Lung injury in 50% of patients
100	Possible fatal injuries
200	Death most likely

*Adapted from: Rice DC, Heck JJ. Terrorist Bombings: Ballistics, patterns of blast injury and tactical emergency care.²⁰



Category of injuries

- Trauma caused by explosions traditionally has been categorized according to the following scheme:
- injury caused by the direct effect of the blast wave (primary injuries)
- effects caused by other objects that are accelerated by the explosive wave (secondary injuries);
- effects caused by movement of the victim (tertiary injuries); and
- miscellaneous effects caused by the explosion or explosives (sometimes termed quaternary injuries)



Clinical Signs/Symptoms Of Significant Explosion-Related Injuries

System	Injury or Condition
Auditory System	Blood oozing from the mouth, nose, or ears Eardrum hyperemia, hemorrhage, or rupture Deafness (may persist) Tinnitus Earache
Cardiovascular	Tachycardia (stress, hemorrhage, hypoxia, exertion, or dehydration) Bradycardia (may be transient due to blast-induced vasovagal reaction) Delayed capillary refill Fall of mean arterial blood pressure (hemorrhage, AGE, vasovagal reaction) Arrhythmia (cardiac irritability due to shock or coronary AGE)
Gastrointestinal	Nausea Vomiting Abdominal tenderness (particularly progressive tenderness) Abdominal rigidity Hematochezia Hematemesis
Neurologic System	Vertigo (vertigo is not usually due to auditory trauma) Coma Altered mental status (may be due to head trauma, shock, or cerebral AGE) Focal numbness Paresthesias Seizures Retrograde amnesia Apathy

Ocular Injury	- Eye irritation - Difficulty focusing - Blindness - Funduscopy findings of retinal artery air embolism - Loss of red reflex on funduscopy examination
Respiratory System	- Cyanosis - Ecchymosis or petechiae in hypopharynx - Asymmetric breath sounds - Cough (often dry) - Tachypnea (often preceded by a short period of apnea) (Rapid shallow respirations are common after blast exposure) - Dyspnea (respiratory difficulty) - Hemoptysis - Rales or moist crepitation in lung fields - Wheezes - Chest pain - Asymmetric chest movement - Subcutaneous emphysema (open wound or rupture of air-containing internal structure)
Miscellaneous	- Tongue blanching (may indicate AGE) - Mottling of nondependent skin (may indicate AGE or hypotension) - Subcutaneous emphysema (open wound) - Pharyngeal petechiae (this has a better predictive value for blast lung than tympanic rupture) - Abrasions

*Dark gray shading indicates most common findings; light gray shading indicates common findings.





Ed evaluation : Code Yellow

- The first priority of the emergency physician faced with the aftermath of an explosion is to activate the hospital's external disaster plan. During the period before the arrival of the first patients, the physician should clear the ED of all possible patients by either discharge or admission. The administration should simultaneously cancel all elective surgery cases, clear the recovery room, and clear as many intensive care beds as possible.
- All injured survivors need to be evaluated with suspicion of primary blast injury. A full set of vital signs is essential and must include the pulse oximetry in all patients.
- ABCDE approach with special consideration of 1st and 2nd wave injury.

Field Medical Care

- Initial care is similar to regular trauma care.
- Identify and correct ABCs of trauma care as rapidly as possible given constraints of multiple casualties.
- Identify and correct life-threatening external hemorrhage at once. This is the most common cause of preventable death on the battlefield.
- Liberal use of field tourniquets is encouraged in recent battlefield medicine guidelines.
- Ear and GI injury do not need special care in the field.
- Rapid evacuation increases the chance of survival.
- Do not attempt definitive care in triage.
- Do not attempt extensive resuscitation in the field. (As noted below, CPR at the scene of a mass casualty is not indicated.)
- Early (ie, from the field) normal vital signs may be an inaccurate guide to the severity of injury in patients with blast lung, barotrauma, and/or hemorrhage and rupture of gas-filled hollow organs.



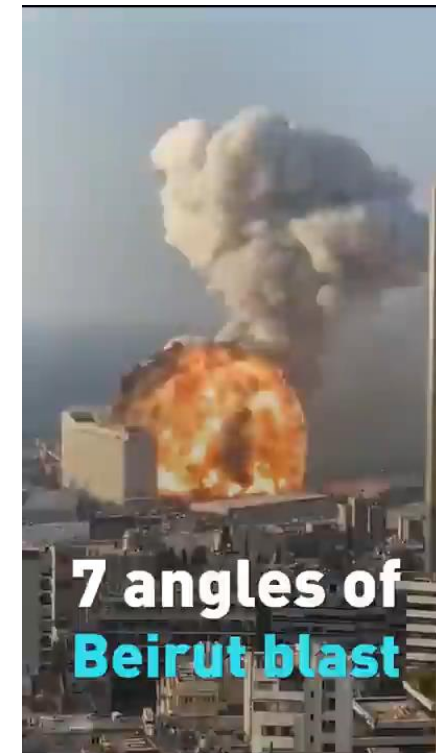
Overview Of Explosion-Related Injuries

System	Injury or Condition
Auditory System	Ruptured tympanic membrane, disruption of the ossicles, damage of the cochlea
Cardiovascular	Myocardial contusion, myocardial infarction from air embolism, cardiogenic shock, peripheral vascular injury, peripheral ischemia from air embolism, shock
Extremity Injuries	Fractures, amputations, crush injury, compartment syndrome, burns, cuts, lacerations, acute occlusion of an artery, air embolism-induced injury
Gastrointestinal	Viscus perforation, hemorrhage, fracture/rupture of liver or spleen, mesenteric ischemia from air embolism, sepsis
Neurologic System	Concussion, closed brain injury, open CNS injury, stroke from air embolism, spinal cord injury. Primary blast injury can cause concussion without a direct blow to the head.
Ocular Injury	Perforated globe, foreign bodies, air embolism, and orbital fractures. Up to 10% of blast injury survivors have significant eye injuries.
Renal Injury	Renal contusion, kidney laceration, acute renal failure due to shock or rhabdomyolysis, testicular rupture
Respiratory System	Blast lung, hemothorax, pneumothorax, pulmonary contusion, pulmonary hemorrhage, arteriovenous fistula (air embolism), airway epithelial damage, aspiration pneumonitis, sepsis. Blast lung is a direct consequence of the HE overpressure wave. It is the most common fatal primary blast injury among initial survivors of an explosion.

*Dark gray shading indicates most common findings; light gray shading indicates common findings. Modified from Centers for Disease Control and Prevention
Mass Trauma

BEIRUT

- <https://youtu.be/eGEmD6j8diU>
- <https://www.theguardian.com/world/gallery/2020/aug/04/beirut-explosion-in-pictures>
- On 4 August 2020, a large amount of ammonium nitrate stored at the port of the city of Beirut, the capital of Lebanon, exploded, causing at least 200 deaths, 6,500 injuries, and US\$15 billion in property damage, and leaving an estimated 300,000 people homeless.[1][2] A cargo of 2,750 tonnes of the substance (equivalent to around 1.1 kilotons of TNT) had been stored in a warehouse without proper safety measures for the previous six years, after having been confiscated by the Lebanese authorities from the abandoned ship MV Rhosus. The explosion was preceded by a fire in the same warehouse, but as of October 2020, the exact cause of the detonation is still under investigation.
- The explosion was felt in Turkey, Syria, Palestine and parts of Europe, and was heard in Cyprus, more than 250 km (160 mi) away. It was detected by the United States Geological Survey as a seismic event of magnitude 3.3, and is considered one of the most powerful non-nuclear explosions in history.



Blast in Saudi

- https://en.wikipedia.org/wiki/List_of_terrorist_incidents_in_Saudi_Arabia

List of all blast in Saudi from 1960s

- <https://youtu.be/PaQ161RrObY>

Riyadh fuel tank explosion

<https://youtu.be/GGfn8CgJEHE>



Conclusion and recommendation

- basic understanding of explosives
- Awareness of basic injuries
- awareness of the THM related to the big blast disaster in the region
- Unique consideration in the medical management.
- Upside down in triage
- Expected number During transfer



Conclusion and recommendation

- injuries are not confined to the battlefield but are Pandemic.
- Seal the Hospital entrances and scan the hospital properly to prevent the tactic of setting of dual explosive to produce more mortalities as first explosion to civilians and second for caregivers and rescuers.
- Consider exposure to carbon monoxide, cyanide or methemoglobin – forming toxins in industrial as well as terrorist explosion.
- Penetrating/blunt trauma to anybody surface is the most common injury seen among Survivors. Patients should require 46 hours of observation.
- Radiological imaging of the head, chest and abdomen will help in early identification injuries.
- Isolated tympanic m. rupture is not a reliable marker of morbidity.
- Delay the primary closure in contaminated wound and give tetanus toxoid and anti-tetanus serum.





*Thank
You*

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